# AN AGENT-BASED-MODELING FOR ELECTORAL PREFERENCE BEHAVIOR: PRESIDENTIAL ELECTIONS OF THE DOMINICAN REPUBLIC 2012

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**Abstract:**

An agent based model was constructed under the assumption that political preferences of individuals change over the campaign because of social interaction and the influence of global information. During the voting decision process take place a phenomenon known as social contagion, aside from institutional factors and personal preferences. Therefore, voters' change of mind may arise and voter's decision analysis might be influenced by polls or commercial campaign.

**Key Words:** Agent-Based-Modeling, Human-Computer-Interaction, Artificial Intelligence, Digital Simulation

## Introduction

An agent-based model is a type of computer model that allows simulation of actions and interactions of autonomous individuals in an environment, in order to determine their effects over whole system. The models simulate the simultaneous operations of multiple entities (agents), in an attempt to re-create and predict the actions of complex phenomena [3].

This computational model provides a mechanism of social contagion in which each agent is subject to the influence of local and global information. The model also allows combining different institutional elements of the electoral process, as debates, campaigns and negative bias induced by TV or other mass media.

The agent model is structured as a cellular automaton in which a two-dimensional lattice characterizes the geographical space of interaction. The transition rule of each agent (or cell) causes the state variable (intention to vote) varies essentially according to local majority opinions (neighbors preference contagion) and global (media influence or propaganda).

## Details of Model

The model described in this paper emphasizes the social contagion among likely voters. It is structured from a cellular automaton where a two-dimensional grid characterizes the geographic space of interaction. The transition rule for each agent makes the state variable (voting intention) varies essentially based on majority views of the population: ***For or against the majority, influenced by the media or influenced by the polls.***

An artificial environment is generated and populated with agents representing *Humans Voters* with different electoral preference (Figure 1). The landscape is an *n*-dimensional cellular automata grid with dimension equivalent to 150x150 square patches and connected circularly. The resulting topology is a torus. The model in question is designed for two parties, based on the average forecast model for the presidential election of the Dominican Republic in 2012, using data from 14 independent surveys from up to 100 days priors to the elections day. The space of social interaction is represented by a grid with 22,500 interactive cells, with borders and Moore neighborhoods type (i.e., each agent has eight neighbors with which it can interact).

Therefore, in this artificial electoral system, the number of potential voters is approximately 22,000 individuals located in a geographical and social context. This simulation can be regarded as corresponding to an average county of the Dominican Republic.  Since the electoral system has approximately the same number of registered voters on an average county.

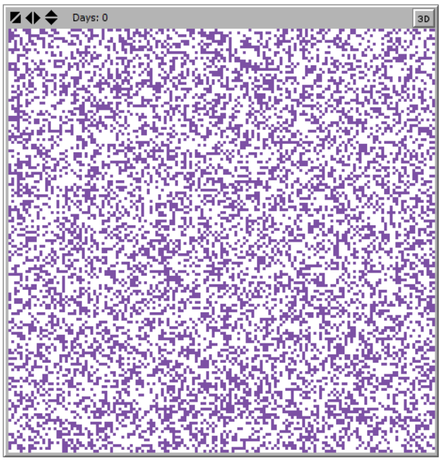



**Figure 1:** Artificially generated environment.

White dots represent followers of Revolution Party. Purple dots represent followers of the Liberation party

Each Voter Agent has a set of attributes that must be set up before running the simulation. Each voter can have a different set of parameters. These values are generated randomly during the instantiation of each agent. These attributes includes:

| Attribute | Description |
|---|---|
| **Party-Vote** | Determines the electoral preference of the agent. *0* prefers Revolution Party (X) *1* prefers Party (Y) |
| **iReadNews** | Determines if the agent consumes media publicity such as TV campaign, Radio, Internet, etc. If it does, the agent is sensible to media campaigns. |
| **Ideology Threshold (Tolerance)** | Determines how malleable the agent is. In electoral terms two states are known as hard-voters and swinger-voters. Hard voters almost never change their preferences. This attribute is set by the calculation of discrete variable finite case [1]. |

$$Tolerance = (x_1 p_1 + x_2 p_2 + \cdots + x_n p_n) \div (p_1 + p_2 + \cdots + p_n)$$

At the beginning of the simulation the electoral scenario can be populated in accordance to a desired composition or distribution of the electoral forces. The initial political preferences of citizens and most of the parameters of the model are calibrated with data from aggregated polls and a database module that tracks the political preferences of the respondents.

For the purpose of our simulation we are using the latest results from a local poll. That places the Revolution Party with a preference of 47% over the Liberation Party with 39%. However the user is free to play with distinct scenarios. The creation of agents is done randomly with a uniform distribution *U [0, USER SET VALUE]*. Attributes are loaded randomly respecting the proportions when they are known. For example, hard voters do not exceed the 30% of the total population for each party [2].

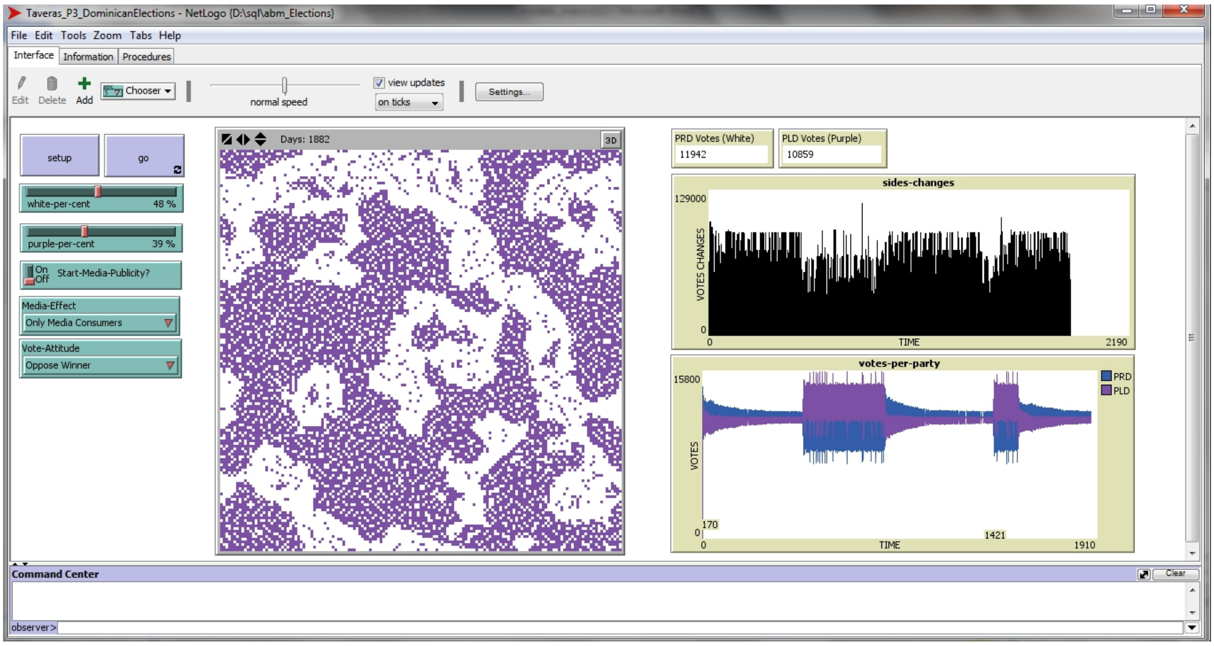



**Figure 2:** Simulation Environment
Agent-based model, providing a range of results produced during a simulation.

## Agent Rules

As mentioned before, initial political preferences of agents and most of the parameters of the model are calibrated with aggregated data from electoral polls and configurable data in the control panel model.

While the party preferences of agents are planted randomly, the values of other variables are set at the beginning of each run based on the following model criteria:

$$A_S = \left( \sum_{k=0}^{n} (x_k \div (Max\ Range\ X\ n)\frac{1}{n} \right) + Tolerance$$

*(Range: 0-100)*

These variables include: ideological commitment (hard-vote and swing-vote), exposure to media, tendency to be influenced by propaganda and socio-demographic attributes (gender, age, education, income and religion). The local information is the sole *source of infection* in the model. This contagion is possible when an agent has been activated in the simulation and communicates with one of its political surrounding partners. The partners are part of the political discussion network that belongs to the vicinity of the agent above a threshold of similarity (i.e., Share at least a number of similar attributes with respect to their political preference). The influence is only viable to the extent that the active agent is not a hard-voter.

In our model, each agent interacts with the neigborhood based upon:

| | | |
|---|---|---|
| $A_s$ | : | Agent political preference |
| $C_s$ | : | Media influence wave |
| $T_A$ | : | Agent threshold tolerance |

Specific rules exist during the simulation:

1. Voters agents are placed randomly around the world. During the run of the model voters move one step at a time, selecting a random

direction from 0 – to 320 degrees. They check their position looking for a collision (neighborhood sight) with other agents (voters). Once it occurs, the human agent check for the following rules:

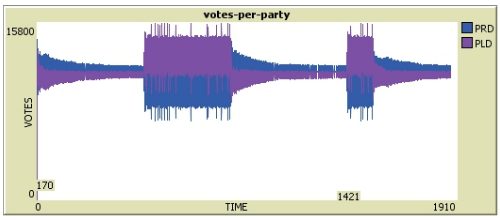
$A_S \geq (C_S - T_A)\ AND\ A_S \leq (C_S + T_A)$

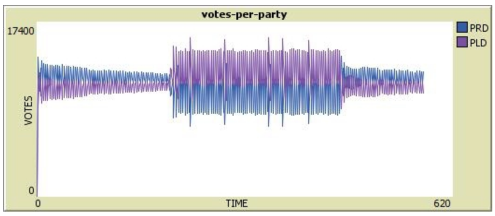
2. Local information is the only source of infection in the model. This contagion is possible when an agent, who has been activated in the simulation, communicates with one of its political partners (neighbors). The partners are part of the network of political discussion if they belong to the neighborhood of the agent and exceed a threshold of similarity. Once the communication occurs, the randomly chosen agent influences the opinion of the neighbor but only when the active agent matches the intension of the majority of the neighborhood.
3. Hard voters' agents only changes if 90% or more of surroundings voters are different and the propaganda is active [4].
4. Weak voters' agents change if more than 50% of the surroundings voters are different independently from the active propaganda [4].
5. If the political campaign activates commercial propaganda, all population is subject to re-think their preferences. With a higher effect on those whose 25% of the surrounding voters are contrary.
6. The simulation could be set to isolate the effect of propaganda only to those agents that are marked as "media consumers".
7. A general behavior can be also activated to simulate the swinging vote of those who "goes with the flow" or when the surroundings of the agents return an even distribution of forces (50%-50%, tie). This means that a setting can be used to determine how some part the population reacts to the actual situation: supporting the expected winner or going against the winner [6].

**Conclusions and Future Studies**

| **Run 1** | | **Run 2** | |
|---|---|---|---|
| PRD Votes (White) | PLD Votes (Purple) | PRD Votes (White) | PLD Votes (Purple) |
| 11942 | 10859 | 12466 | 10335 |

**Distribution of Electoral Forces Over Time**



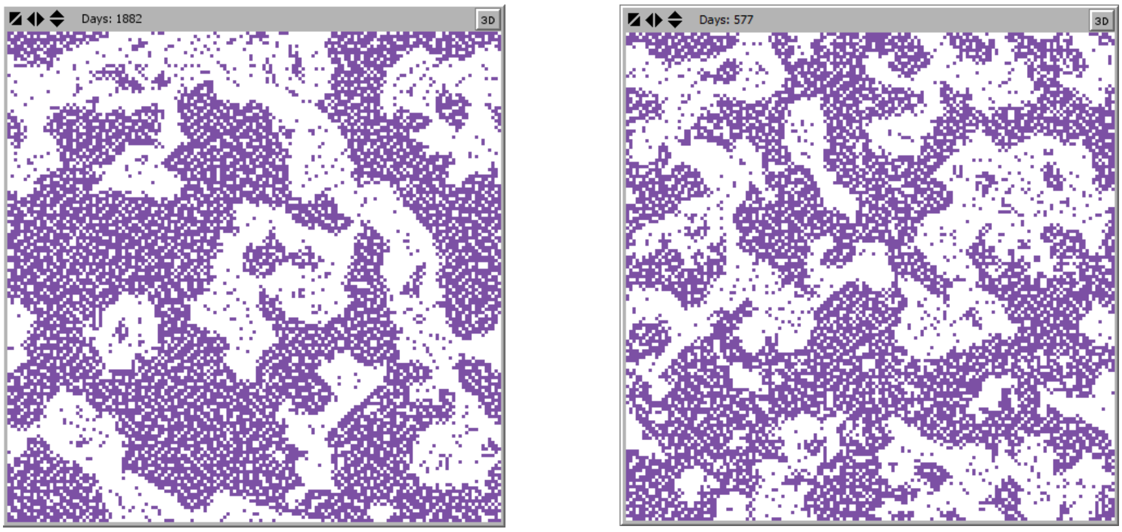



**Figure 3:** Results from various simulations executions

Figure 3 shows the results of two executions of the model. Each run was executed for 780 ticks, simulating an amount of week's equivalent to 90 calendar days. The agent simulation shows two major trends on the actual behavior of the Dominican Republic electoral population:

1. The simulation confirms that the political distribution of the electoral force on the Dominican Republic is polarized. In any given run, any of the wining parties never gets more than 54% of the total voters. Our conclusion is that this phenomenon responds in part to the 30% of hard votes that is a known constant in the Dominican scenario and the 14% of fluctuating voters who are very sensible to media and the influence of other agents.
2. The simulation confirms that the population is very sensible to the media campaign. It is evident in the resulting graphics that, whenever the Media Campaign is activated, the composition of the chart reflects a mirror effect (Figure 3, Run 1).
3. All the time there is people changing their minds, and these voters are recycled over and over from one party to another. From this can be concluded that the timing on the election and the selection of critical dates for campaign or compromising people, is a critical factor that requires attention when designing the electoral strategy. 9%-15% of the voters doesn't stay for too long on one side, and are always willing to listen for new offers (Figure 3, Run 2).

**Behavior of Population Changing Votes Intention**

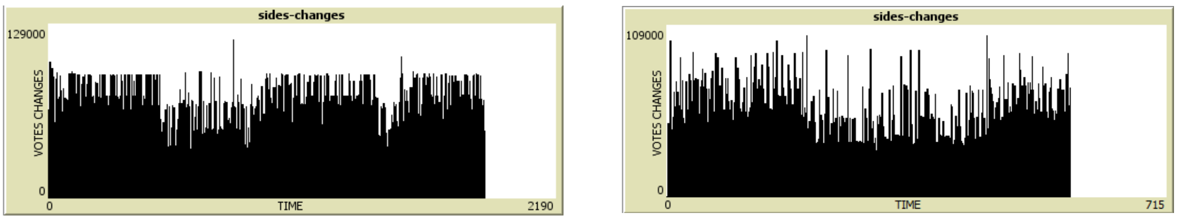



**Figure 4:** Behavior of Population Changing Party Sides

**Future Work**

The model could be optimized by including a set of agents that are indifferent to the elections and therefore does not participate in the process. These are called "abstaining voters". The actual simulation does not consider such type of population. Another element that will be developed for future analysis is the inclusion of socio economic attributes to each agent and the some sort of communication behavior for a special type of agent known as “activist” or local leader, which can work directly with agents around its area to neutralize the effect of massive propaganda.

The actual system manage approximately 11 million records that could be cross referenced with various databases to produce what is called “electoral characterization”, which in orders words means, defining specific profiles for potential voters in order to develop a “custom campaign” for each person or group. We are also implementing data mining techniques combined with social network analysis and recommendation algorithms.

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